

Studies Probe Role of Minerals in Brain Function

If you've been having trouble concentrating, maybe you're not getting enough of the nutrients your brain needs.

Studies by ARS physiologist Mary J. Kretsch and colleagues are revealing new clues about the roles essential nutrients apparently play in keeping our mental capacities—or what scientists call “cognitive function”—up to par. She is based at the ARS Western Human Nutrition Research Center in Davis, California.

Mental capabilities, such as memory and the ability to concentrate, are essential to carrying out responsibilities at home, work, and school. In the Information Age, especially, our mental productivity is critical to our success at work.

Yet, much of the research that links inadequate nutrition to mental performance has been done with children. And as Kretsch points out, “those studies have, for example, linked poor nutrition to impaired learning at school. Our work is with adults and focuses not on outright shortages of essential nutrients, but instead on marginal deficiencies.”

Iron Decline Shortens Attention Span

In a 20-week study with eight healthy men, aged 27 to 47 years, Kretsch looked at the relationship between iron and the volunteers' ability to concentrate. “We saw that a low score for volunteers' attention span corresponded with a subsequent decline in iron levels in the body.”

In an earlier study with 14 obese but otherwise healthy female volunteers, aged 25 to 42 years, Kretsch and colleagues had documented a similar change in ability to focus. The 21-week experiment showed that volunteers with borderline anemia, as measured by blood hemoglobin, were less able to concentrate than volunteers with higher hemoglobin. However, because blood hemoglobin can be influenced by nutrients other than iron, Kretsch measured other indicators of iron status, as well. Those tests also showed that iron status declined for those volunteers with the lower ability to concentrate.

Her studies are the first—in healthy adults—to link a decrease in iron with a decline in attention span. Kretsch says the findings suggest that decreased ability to concentrate may be an early indicator that an individual's iron levels are declining.

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Technician Annie Hwang (left), chemist Manuel Tengonoiang, and research associate Leslie Woodhouse prepare blood and urine samples for iron and zinc analysis on an inductively coupled plasma atomic emission spectrometer.

“Somewhat the same trend has been observed in studies elsewhere with children. It's been found, for instance, that children with iron deficiency anemia have a short attention span,” Kretsch says.

“We plan followup studies, with healthy adults, to investigate whether iron supplementation can reverse this cognitive impairment. We would also like to learn more about the mechanisms at work here.”

Kretsch plans to recruit premenopausal

women as volunteers for these next studies. That's because iron deficiency and iron-deficiency anemia are still relatively common in the United States among women of that age group, as well as among adolescent females.

Kretsch and co-workers measured volunteers' ability to concentrate by giving them a 6-minute-long standardized test. "We presented a continuous, fast-moving stream of single-digit numbers on a computer screen," she says. "We asked the volunteers to quickly press the



space bar on the computer keyboard whenever they saw either three even or three odd numbers in a row. That may sound easy, but it's actually a demanding task that requires paying attention."

Low Zinc Leads to Faulty Memory

Kretsch and co-researchers also explored the interaction of brainpower and another nutrient, zinc. She worked with the same eight men who participated in the iron tests.

In one test of mental function, called verbal memory, the scientists evaluated the volunteers' ability to remember everyday words. "We showed the men a list of words on a computer screen. Then, we presented these words again, this time intermingled with new ones, and asked the volunteers to press a key whenever they recognized a word from the first list," says Kretsch.

Preliminary results showed that, after only 3 weeks on a low-zinc regimen, many of the volunteers' ability to recall the words slowed. The men who slowed the most in this test also had the greatest decrease in blood levels of zinc.

Several weeks later, while still in the low-zinc phase of the study, some of these volunteers more quickly identified what they thought were the correct words, but speed came at the expense of accuracy. "This trade-off of speed for accuracy," says Kretsch, "doesn't represent an improvement in their ability to adjust to a low-zinc regimen." The speed-for-accuracy response agreed with findings of a 1984 zinc study of healthy men, conducted by researchers at the ARS Grand Forks Human Nutrition Research Center.

"In all studies," Kretsch reports, "cognitive changes were evident before biochemical changes occurred. This supports previous iron and zinc work with primates, which showed that cognitive changes can occur well ahead of other indicators of decreased iron or zinc. We think these cognitive tasks might prove to be a simple way to identify people who aren't getting enough iron or zinc—well before any signs show up in biochemical samples such as blood or urine."

Kretsch's collaborators in the iron study included psychologist Michael W. Green of the Neurosciences Research In-

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Physiologist Mary Kretsch (right) and registered dietician Monique Derricote demonstrate the Bakan Vigilance Task, which measures the ability to sustain attention.

stitute at Aston University, Birmingham, England, and—in the zinc study—psychologist James G. Penland of the ARS Grand Forks Human Nutrition Research Center. Among Kretsch's other co-investigators are Janet C. King, director of the ARS Western Human Nutrition Research Center; and Alice K.H. Fong, Herman L. Johnson, and Barbara Sutherland, formerly with the center.

The researchers have published their findings in the *European Journal of Clinical Nutrition*, the *FASEB Journal*, and in a book, *Trace Elements in Man and Animals*.—By **Marcia Wood**, ARS.

This research is part of Human Nutrition, an ARS National Program (#107) described on the World Wide Web at <http://www.nps.ars.usda.gov>.

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